Canopy Arm Quality Issues Investigation Status

June 6, 2019

Canopy Quality Issues

- HART was notified of quality issues on two of the station groups
- On the FHSG group, cracks in the steel were observed in 4 canopy arms not yet shipped
- Initial investigation indicates that the canopy arms may have developed cracks during the galvanizing process
- The 10 canopy arms that have been delivered to site are not being installed at this time
- HART has put both the contractor and designer on notice, and both are cooperating in developing an analysis and a resolution to the issue

Canopy Quality Issues

- The second of two of the station groups is WOSG
- On the WOSG group, cracks in the steel were observed in 1 canopy arm that was shipped to the site
- 16 canopy arms have been delivered to site and all except the one with the crack have been installed
- HART has put both the contractor and designer on notice, and both are investigating a potential fix

Defects

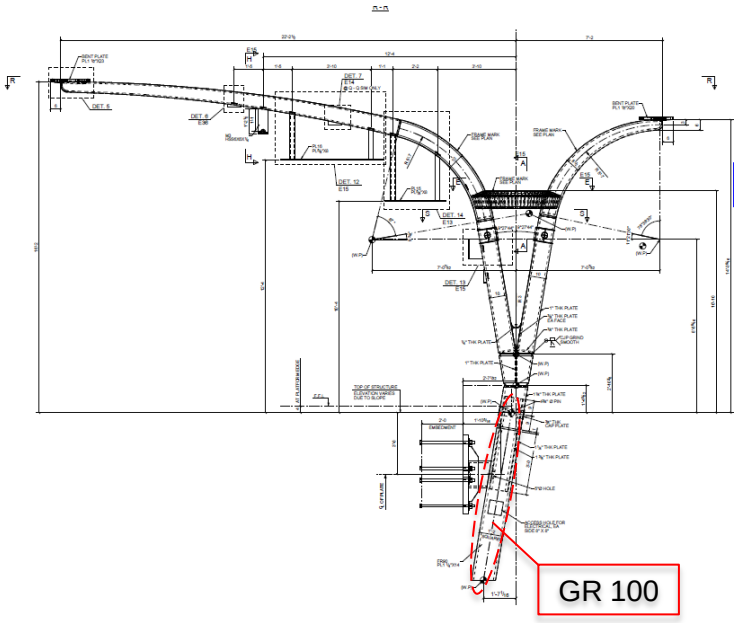
West Oahu Station Group – Ho'opili Station

Lower frame segment crack – 1 Frame
Nan, Inc. & TMP (fabricator)

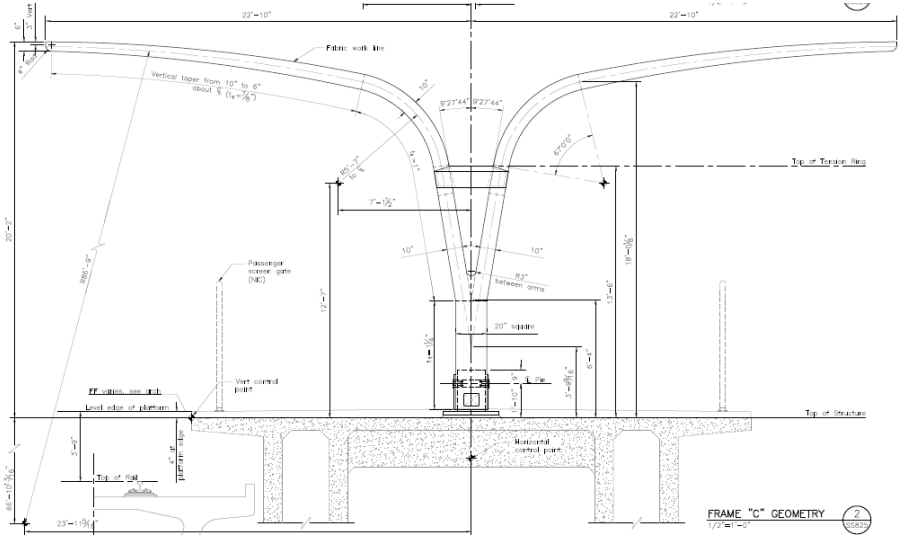
Farrington Highway Station Group – West Loch Station (WLO)

Lower frame segment cracks – 4 Frames
HDCC, Inc. & SSW (fabricator)

Background



Side Platform Frame



Center Platform Frame

Quality Issues

West Oahu Station Group (Nan, Inc.)	Farrington Highway Station Group (HDCC, Inc.)	Kamehameha Highway Station Group (Nan, Inc.)
Contractor Notification to HART: Last week April	Contractor Notification to HART: Last week April	Notified: None
1 lower segment (Ho`opili - side platform) delivered cracked (Gr 100) All other frames erected	4 cracked lower segments @ factory in KS (WLO) 10 lower segments delivered to MSF (WTC)	Proceeding with Center Platform fabrication (Gr 50) Side Platform (Gr 100 Elements) – On Hold
Collecting documentation	Cracks occurred after welding, possibly during galvanizing	HART notified contractor & designer
HART notified contractor & designer	HART notified contractor & designer	
	Parties are cooperating, developing an analysis and resolution	

Approach

HART's Goals & Objectives for Roof Canopy Structures

A. Establish that Design is safe, and that Construction delivers on Design requirements

B. Based on metallurgical science and engineering, get failure analysis underway and establish causal contributing factors

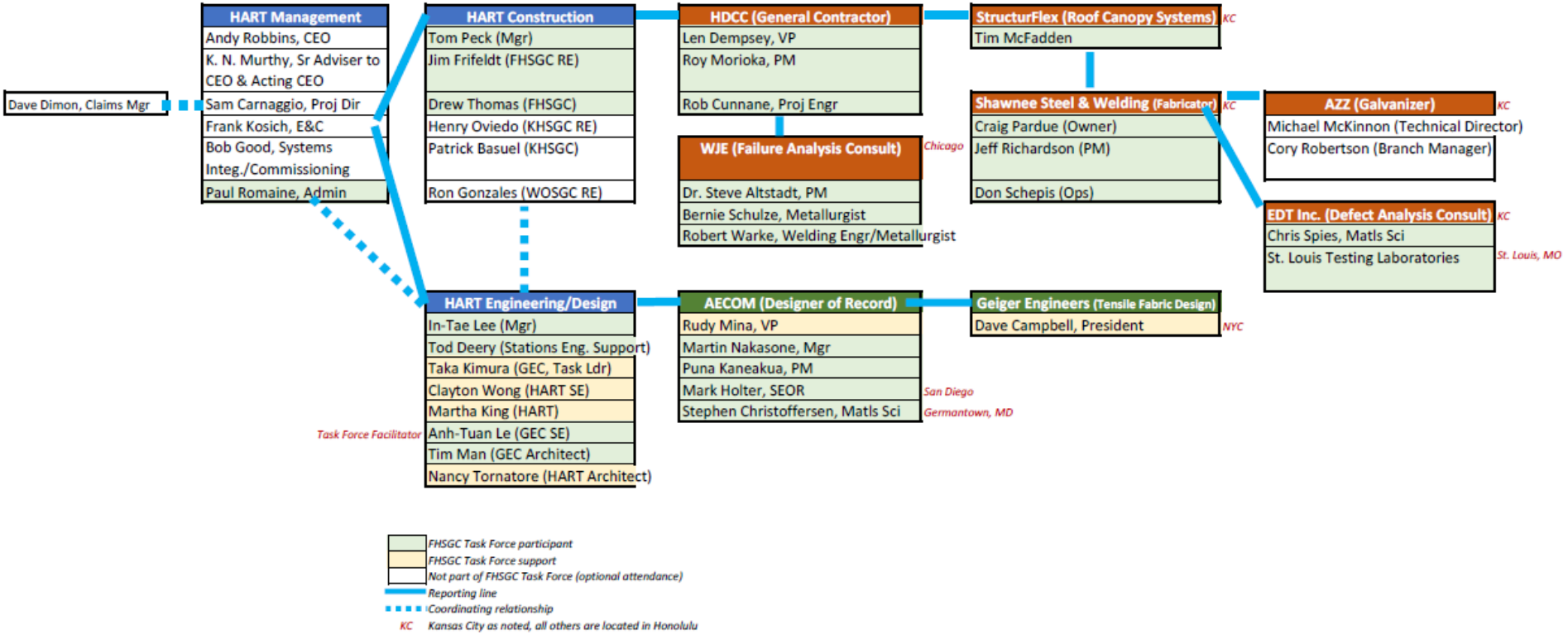
C. Determine structural adequacy of fabrications performed and decide on their disposition

D. Determine the need for any modifications to current design and specifications

E. Determine the need for any modifications to current contractor/fabricator means & methods

F. Develop "Plan B" to fast-track alternate design and fabrication activities to avoid potential program delays associated with reported risks of high strength Gr 100 steels

FHSG Investigation – Task Force Team



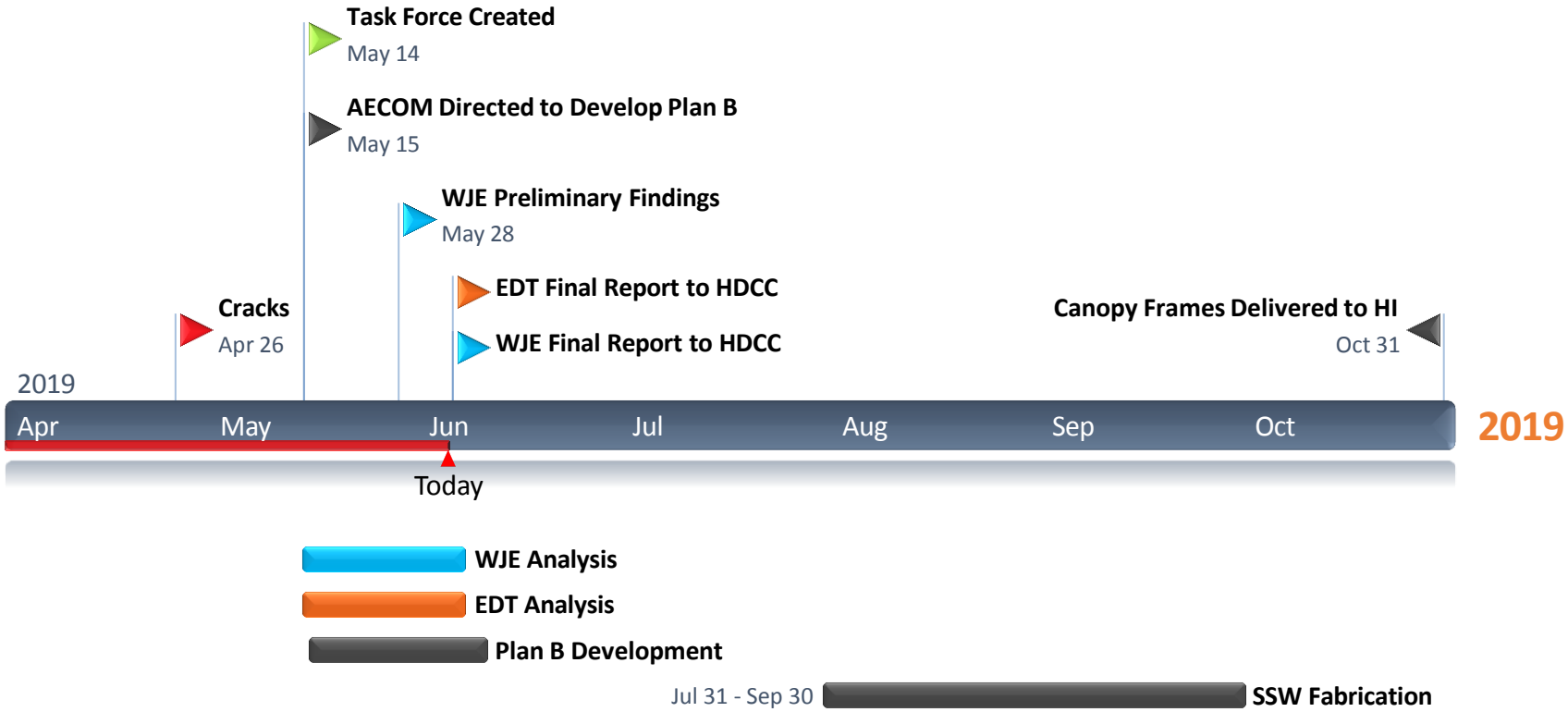
Preliminary Analysis

- WOSG – collecting documentation; field weld repair was unacceptable

- FHSG - canopy frame lower segment analysis begun
  80%-90% of crack filled with zinc (galvanizing material)
- Preliminary hypothesis based upon Wiss, Janney, Elstner (WJE) assessment: Cracks are result of either liquid metal embrittlement (LME), hydrogen embrittlement (HE) or strain age embrittlement
- High residual stresses due to fabrication methods (e.g. welding and plasma cutting) and thermal shock due to hot dip galvanization (HDG)
  Lower segment is Grade 100 steel

- KHSG – Gr 100 fabrication on hold

FHSG Action Plan/Schedule



Questions

Mahalo!